PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PC-21005660	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/SE 2003/001436	International filing date *(day/month/year)* 12.09.2003	Priority date *(day/month/year)* 13.09.2002
International Patent Classification (IPC) or national classification and IPC C02F 11/04		
Applicant Kemira OYJ et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 8 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 3 sheets, as follows:
      ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☒ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
19.01.2004	16.12.2004
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Form PCT/IPEA/409 (cover sheet) (January 2004)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE 2003/001436

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

☐ international search (under Rules 12.3 and 23.1(b))
☐ publication of the international application (under Rule 12.4)
☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-33 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 34-36 received by this Authority on 21-09-2004
pages* _____ received by this Authority on _____

☒ the drawings:

pages 1-6 as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE 2003/001436

Box No. II Priority

1. ☐ This report has been established as if no priority had been claimed due to the failure to furnish within the prescribed time limit the requested:

   ☐ copy of the earlier application whose priority has been claimed (Rule 66.7(a)).

   ☐ translation of the earlier application whose priority has been claimed (Rule 66.7(b)).

2. ☐ This report has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rule 64.1). Thus for the purposes of this report, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

The priority is considered valid. Document WO 03/059825 A1, cited in the International Search Report, is therefore not considered in the statement regarding inventive step in box V.

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

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Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims		NO
Inventive step (IS)	Claims		YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Most relevant documents cited in the International Search Report:

D1: DE 30 18 018 A1
D2: DE 198 45 207 A1
D3: JP 59177197
D4: JP54136747
D5: EP0220647A1

The present invention intends to solve the problem of providing a new method for sludge processing and disposal.

The closest prior art is represented by D1.

D1 discloses a method for anaerobic digestion of organic matter, such as sludge. The object in D1 is to shorten the treatment time and increase the amount of recovered gas, while avoiding problems associated with mixing feed sludge with re-circulated digested sludge (refer to page 3, "Beschreibung" and lines 4-5 from the end of page 3). D1 disclose an enzymatic pre-treatment, using e.g. amylase, lipase and proteases, followed by addition of methane bacteria to the pre-treated sludge, which is subsequently digested at 38°C under agitation by blowing in recovered biogas (refer to page 4, "Lösung", (a)-(e)). The method further comprises hygienisation at 70°C and pH 12 after the enzymatic treatment and prior to digestion (refer to page 5, last paragraph). The enzymes disclosed in D1 are capable of digesting natural polymeric materials.

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: V

CLAIMS 1-3 AND 8-20:

The invention according to claims 1 and 2 differs from what is disclosed in D1 since a mixture of enzymes is not explicitly mentioned in D1. However, it is apparent that more than one type of enzyme is to be used. Therefore, it is considered obvious to a person skilled in the art to apply a mixture of the enzymes suggested in D1 and the subject matter of claims 1-2 is thus considered to lack an inventive step.

Some of the enzymes in claims 3 are not disclosed in D1. However, in the absence of evidence that any particular effect would be obtained by using those enzymes, as compared to the pre-treatment according to D1, the subject matter of claim 3 is considered to lack an inventive step, for the same reasons as set out for claims 1-2.

The subject matter of claims 8-9, 14 and 15 i.e. hygienisation, enzyme doses and temperature is apparent from D1 or considered obvious, and thus lacks an inventive step.

D1 mentions the use of methanogenic bacteria. It is obvious to a skilled person that addition of other types of fermenting bacteria in the process according to D1 might be necessary too, because of the pre-hygienisation step. Therefore, the invention according to claims 10-13 is considered to lack an inventive step in view of D1.

The subject matter of claims 16-18, i.e. agitation, thickening and chemical/physical/mechanical pre-treatments are conventional sludge treatment steps which belongs within common skill, and has not been shown to give rise to any unexpected effects. Claims 16-18 thus lacks an inventive step.

Furthermore, it is considered obvious to a skilled person to use the process according to D1 either in addition to or instead of conventional digestion, as set out in claims 19-20. Said claims thus lack an inventive step.

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: V

CLAIMS 4-7:

Claims 4-7 relate to the use of a surfactant in the enzyme mixture. Surfactants are not mentioned in D1.

The effect of the surfactant is to increase the bio-availability of the substrate by affecting the surface tension. The problem solved by the invention according to claims 4-7 in relation to D1 is thus to increase the bio-availability of sludge in connection with anaerobic digestion and enzymatic pre-treatment.

A solution to this problem is disclosed in D2, which describes an enzyme preparation for increasing the bio-availability of sludge in connection with digestion (refer to page 2, lines 3-5 and 33-36). The enzyme preparation according to D2 may comprise e.g. cellulose, protease, amylase, pectinase and non-ionic or cationic surfactants (refer to page 2, lines 37-65).

Since D1 gives no detailed instructions as to which enzymes to use, a skilled man starting from D1 would use a known product intended for improving anaerobic digestion. He would therefore use the preparation disclosed in D2 in the process according to D1 so as to arrive at the invention according to claims 4-5. The combination is obvious since D1 and D2 are technically very closely related. Since non-ionic surfactants are recommended in D2, it is also considered obvious to use any of the substances, known per se, disclosed in claim 6. The surfactant content disclosed in claim 7 is not considered inventive with respect to the combination of D1 and D2. Thus, the invention according to claims 4-7 is considered to lack an inventive step in view of D1 in combination with D2.

Finally, documents D3-D5 all relate to improving the efficiency of anaerobic sludge digestion through enzymatic pre-treatment and are also considered relevant regarding

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: V

inventive step with respect to the claimed invention (refer to abstracts of D3 and D4 and page 4, lines 36-51 and page 6, lines 29-49 in D5). The same type of argumentation regarding inventive step as with D1 is possible.

Claims 1-3 and 8-20 is considered to lack an inventive step in view of each of D3 and D5 and claims 1-3, 8-17 and 19-20 is considered to lack an inventive step in view of D4.

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE 2003/001436

Box No. VI Certain documents cited

1. Certain published documents (Rule 70.10)

Application No. Patent No.	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date (valid claim) *(day/month/year)*
WO 03/059825 A1	24-07-2003	18-12-2002	02-01-2002

2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure	Date of non-written disclosure *(day/month/year)*	Date of written disclosure referring to non-written disclosure *(day/month/year)*

CLAIMS

1. A method for digestion of sludge in water purification, c h a r a c t e r i s e d by the steps:

a) providing at least one enzyme mixture capable of digesting natural polymeric materials;

b) adding the at least one enzyme mixture sequentially to an aqueous sludge suspension; and thereafter,

c) optionally adding at least one species of fermenting bacteria to the suspension, thereby fermenting the resulting suspension obtained in step b),

wherein enzymes in the at least one enzyme mixture are chosen from cellulases, cellobiases, amylases, lipases, pectinases, dextranses, oxidoreductases, proteases, pulpzymes and oxidases,

and the natural polymeric materials are proteins, polysaccharides, polyphenols (lignins), fats, waxes, and mineral oils.

2. A method according to claim 1, wherein at least one species of fermenting bacteria is added to the suspension in step c), thereby fermenting the resulting suspension obtained in step b).

3. A method according to claim 1 or 2, c h a r a c t e r i s e d by that the enzymes in a first enzyme mixture are chosen from cellulases, cellobiases, amylases, lipases, pectinases, dextranses, oxidoreductases, pulpzymes and oxidases, and the enzymes in a second enzyme mixture are chosen from cellulases, cellobiases, amylases, lipases, pectinases, dextranses, oxidoreductases, proteases, pulpzymes and oxidases.

4. A method according to any one of claims 1-3, c h a r a c t e r i s e d by that the enzyme mixture(s) comprise(s) a surfactant.

5. A method according to claim 4, c h a r a c t e r i s e d by that the surfactant is non-ionic.

6. A method according to claim 5, c h a r a c t e r i s e d by that the surfactant is chosen from natural and synthetic alcohol ethoxylates, FAE (fatty alcohol ethoxylate), non-ionic surface active agents prepared by the addition of ethylene oxide to propylene glycols, polydimethylsiloxane co-polymers and polyoxyethylene derivatives of fatty acid partial esters of hexitol anhydrides.

7. A method according to claim 6, c h a r a c t e r i s e d by that the surfactant is present in the range of 0.0025-5 w/w % of the sludge suspension, in particularly in the range of 0.0025-2 w/w %.

8. A method according to any one of claims 1-7, c h a r a c t e r i s e d by that the dose of the enzyme mixture in relation to sludge suspension is 0.2-0.001% enzyme per 1% TS sludge.

9. A method according to 8, c h a r a c t e r i s e d by that the dose is 0.06-0.001% enzyme per 1% TS sludge.

10. A method according to any one of claims 1-9, c h a r a c t e r i s e d by that the fermenting bacteria are chosen from acidogenic bacteria, acetogenic bacteria, and methane producing bacteria.

11. A method according to claim 10, c h a r a c t e r i s e d by that the fermenting bacteria are chosen from Gluconobacter oxydans, Acetobacter species, Acetogenium kivui, Bacillus macerans, polymyxa, Bacillus coagulans, Lactobacillus buchneri, Clostridium thermoaceticus, Clostridium lentocellum, Clostridium formicoaceticu, Clostridium thermocellum and Pseudomonas species.

12. A method according to claim 11, c h a r a c t e r i s e d by that at least one of the species of the fermenting bacteria is methane producing bacteria.

13. A method according to claim 12, c h a r a c t e r i s e d by that the methane producing bacteria are chosen from Methanosarcina barkeri, Methanosarcina

mazeii, Methanosarcina soehngenii and Methanosarcina acetivorans, and Methanosaeta, and mixtures thereof.

14. A method according to claim 13, c h a r a c t e r i s e d by that the methane produced is separated from the sludge suspension.

15. A method according to any one of claims 1-14, c h a r a c t e r i s e d by that the temperature of the sludge suspension is from 20°C to 90°C.

16. A method according to any one of claims 1-15, c h a r a c t e r i s e d by that the sludge suspension is subjected to agitation in the range from 0 to 180 rpm.

17. A method according to any one of claims 1-16, c h a r a c t e r i s e d by that the sludge is pre-concentrated, prior to the addition of enzymes and bacteria, by gravitation or enhanced sedimentation to the range 10-300 g sludge solids per 1 l sludge suspension.

18. A method according to any one of claims 1-17, c h a r a c t e r i s e d by that the sludge suspension is subjected to a pre-treatment chosen from the group comprising acid treatment, base treatment, sonication, grinding and heating.

19. Use of a method according to any one of claims 1-18, in addition to conventional digestion used in water purification.

20. Use of a method according to any one of claims 1-18, instead of conventional digestion used in water purification.